CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

RESOLUTION NO. R5-2002-0200

RESOLUTION APPROVING THE REGIONAL TOXIC HOT SPOT CLEANUP PLANS FOR DIAZINON ORCHARD DORMANT SPRAY, URBAN PESTICIDES, AND IRRIGATION RETURN FLOW PESTICIDES

WHEREAS, in 1989, the California Legislature established the Bay Protection and Toxic Cleanup Program (BPTCP) to: 1) provide protection for present and future beneficial uses of bay and estuarine waters of California, 2) identify and characterize toxic hot spots, 3) plan for toxic hot spot cleanup or other remedial or mitigation actions, and 4) develop prevention and control strategies for toxic pollutants that will prevent creation of new toxic hot spots or perpetuation of existing ones within the bays and estuaries of the state; and

WHEREAS, California Water Code Section 13394 required the State Water Resources Control Board (State Water Board) and the Regional Boards to develop Regional and Consolidated Toxic Hot Spot Cleanup Plans by 30 June 1999; and

WHEREAS, a Water Quality Control Policy for Guidance on the Development of Regional Toxic Hot Spot Cleanup Plans was adopted by State Water Board on 2 September 1998; and

WHEREAS, on 29 April 1999, the Regional Board approved a Regional Toxic Hot Spot Cleanup Plan that identified three toxic hot spots related to pesticides (Resolution No. 99-001) Previously, on 22 February 1999, the Regional Board had requested a variance to allow the Regional Board to address pesticide regulation for the three pesticide toxic hot spots under the Clean Water Act Section 303(d) Total Maximum Daily Load process instead of the Bay Protection Program; and

WHEREAS, on 17 June 1999, State Water Board adopted Resolution No. 99-065 adopting the Consolidated Statewide Toxic Hot Spot Cleanup Plan and approving three site-specific variances to allow the Regional Board to address pesticide regulation under the Clean Water Act Section 303(d) Total Maximum Daily Load process; and

WHEREAS, in 1999, a lawsuit was filed by the San Francisco Baykeeper (now Deltakeeper) and Bill Jennings (petitioners) challenging, among other things, the site-specific variances for pesticides; and

WHEREAS, on 11 October 2001, the Sacramento County Superior Court entered a Judgment in favor of the petitioners and issued a writ of mandate directing that the site-specific variances for the pesticide toxic hot spots identified in the Consolidated Statewide Toxic Hot Spots Cleanup Plan be vacated and set aside, and further directing

that the Regional Board and State Board undertake the necessary actions to prepare and submit to the Legislature an amended cleanup plan for the pesticide toxic hot spots; and

WHEREAS, on 15 November 2001, the State Water Board vacated and set aside the site specific variances in the Consolidated Statewide Toxic Hot Spots Cleanup Plan; and

WHEREAS, on 15 April 2002, the court approved a compliance schedule that requires the Regional Board to adopt amended cleanup plans for the pesticide toxic hot spots by 6 December 2002 and further requires the State Water Board to submit an adopted amendment to the Consolidated Cleanup Plan setting forth these cleanup plans to the Office of Administrative Law by 1 September 2003; and

WHEREAS, Regional Board staff prepared draft amended cleanup plans and, on 10 June 2002, notice was given to all interested persons of the availability of draft amended cleanup plans; and

WHEREAS, the Regional Board received comments from interested persons and prepared responses to those comments; and

WHEREAS, notice of a public hearing on the draft amended cleanup plans was sent to all interested persons and published in accordance with applicable law; and

WHEREAS, the Regional Board held a public hearing on 6 December 2002, for the purpose of receiving testimony on the draft amended cleanup plans; and

WHEREAS, the Cleanup Plans must be incorporated into the Consolidated Statewide Toxic Hot Spots Cleanup Plan and approved by the State Water Board and Office of Administrative Law (OAL) before becoming effective; and

WHEREAS, the Regional Board finds that the proposed Cleanup Plans were developed in accordance with California Water Code section 13394.

THERFORE BE IT RESOLVED, that after considering the entire record, including oral testimony at the hearing, the Regional Board approves the amended Cleanup Plans as set forth in Attachment A; and

RESOLVED that the Executive Officer is directed to forward copies of the Cleanup Plans to the State Water Board for incorporation into the Consolidated Statewide Toxic Hot Spots Cleanup Plan, in accordance with the requirements of Section 13394 of the California Water Code; and

RESOLVED, that if during the approval process the State Water Board or OAL determines that minor, non-substantive corrections to the language of the amendment are needed for clarity or consistency, the Executive Officer may make such changes, and shall inform the Regional Board of any such changes; and

RESOLVED, that the Executive Officer should request that the State Board remand the Cleanup Plans to the Regional Board for further consideration if a stipulation with petitioners San Francisco Baykeeper (now Deltakeeper) and Bill Jennings to extend the compliance schedule is reached and approved by the court.

I, THOMAS R. PINKOS, Executive Officer, do hereby certify the foregoing is a full, true, and correct copy of a Resolution adopted by the California Regional Water Quality Control Board, Central Valley Region, on 5 December 2002.

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THOMAS R. PINKOS, Executive Officer

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

BAY PROTECTION PROGRAM TOXIC HOT SPOT CLEANUP PLANS FOR

DIAZINON IN ORCHARD DORMANT SPRAY
DIAZINON AND CHLORPYRIFOS IN URBAN STORMWATER
CHLORPYRIFOS IN IRRIGATION RETURN FLOW

Final Report

December 2002

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

BAY PROTECTION PROGRAM TOXIC HOT SPOT CLEANUP PLANS FOR DIAZINON IN ORCHARD DORMANT SPRAY DIAZINON AND CHLORPYRIFOS IN URBAN STORMWATER CHLORPYRIFOS IN IRRIGATION RETURN FLOW

December 2002

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Background

In 1999, the Central Valley Regional Water Quality Control Board (Regional Board) determined that diazinon in orchard dormant spray runoff caused toxic conditions in the Sacramento-San Joaquin Delta that warranted identifying the entire Delta as a candidate high priority toxic hot spot. The Consolidated Hot Spot Cleanup Plan adopted by the State water Resources Control Board (State Board) in 1999 in Resolution No. 99-065 identified this candidate hot spot as a known toxic hot spot. Diazinon from orchards has also been noted in the Central Valley Region's 303(d) list as water quality impairments in the main stem Sacramento and San Joaquin Rivers and in the Delta. This plan primarily addresses the cleanup plan requirements of the Bay Protection and Toxic Hot Spot Cleanup Program (BPTCP) but was also written to be consistent with the proposed actions and schedules of the 303(d) listing.

Approximately one million pounds of insecticide active ingredient were applied in January and February in the Central Valley on about half a million acres of stonefruit and almond orchards to control boring insects (Foe and Sheipline, 1993). Diazinon accounts for about half the application. In recent years the use of diazinon as a dormant spray has declined. It is not known whether this reduced use pattern will continue. Numerous chemical studies and toxicity tests have measured diazinon in surface water samples in the Central Valley during winter months at toxic concentrations to sensitive invertebrates (Foe and Connor, 1991; Foe and Sheipline, 1993; Ross, 1992 and 1993; Foe, 1995; Domagalski, 1995; Kratzer, 1997). The typical pattern is that the highest concentrations and longest exposures are in small water courses adjacent to high densities of orchards. However, after large storms in 1990 and 1992, diazinon was measured in the San Joaquin River at the entrance to the Delta at toxic concentrations to the cladoceran invertebrate *Ceriodaphnia dubia* in U.S. EPA three species toxicity tests (Foe and Connor, 1991; Foe and Sheipline, 1993). Following up on these findings, the US Geological Survey and Regional Board traced pulses of diazinon from both the Sacramento and San Joaquin Rivers across the Delta in 1993 (Kuivilla and Foe, 1995). Toxic concentrations to *Ceriodaphnia* were observed as far west in the Delta as Chipps Island, some 60 miles downstream of the City of Sacramento and the entrance to the Delta.

Concern has been expressed that other contaminants might also be present in winter storm runoff from the Central Valley and contribute to invertebrate mortality. Therefore, in 1996, toxicity identification evaluations (TIEs) were conducted on three samples testing toxic in *Ceriodaphnia* toxicity tests from the San Joaquin River at Vernalis Foe et al., 1998). The results confirm that diazinon was the primary contaminant although other unidentified chemicals may also have contributed a minor amount of toxicity. The study was repeated in 1997 with the exception that samples were taken further upstream in the Sacramento and San Joaquin watersheds in the hope of collecting water with greater concentrations of unknown toxicants thereby facilitating their identification. TIEs were conducted on samples from Orestimba Creek in the San Joaquin Basin on 23 and 25 January and from the Sutter Bypass on 23, 25, and 26 January. Again, diazinon was

confirmed as the primary toxicant (Foe at al., 1998). No evidence was obtained suggesting a second contaminant.

No biological surveys have been undertaken to determine the ecological significance of toxic pulses of diazinon. However, Novartis, the registrants for diazinon, has completed a diazinon probabilistic risk assessment for the Central Valley (Novartis Crop Protection, 1997). Little data were available for the Delta. The risk assessment, like chemical and toxicity test studies, suggests that the greatest impacts are likely to occur in water courses adjacent to orchards. Lower concentrations are predicted in mainstem Rivers. The report predicts that the Sacramento and San Joaquin Rivers will experience acutely toxic conditions to 10% of the most sensitive species 0.4 and 11.6% of the time in February, the period of most intensive diazinon off-site movement. Novartis concludes that the risk of diazinon alone in the Sacramento-San Joaquin River basin is limited to the most sensitive invertebrates, primarily cladocerans. Furthermore, the report notes that cladocerans reproduce rapidly and their populations are therefore predicted to recover rapidly. Also, the report predicts that indirect effects on fish through reductions in their invertebrate prey are unlikely as the preferred food species are unaffected by the diazinon concentrations observed in the rivers. However, the study recommends that the population dynamics of susceptible invertebrate species in the basin be evaluated along with the feeding habits and nutritional requirements of common fish species.

In conclusion, the only major use of diazinon in the Central Valley in January and February is on stonefruit and almond orchards. In 1990, 1992, 1993, and1996, diazinon was observed entering the Delta from either the Sacramento or San Joaquin Rivers at toxic concentrations in *Ceriodaphnia* toxicity tests. In 1993, the chemical was followed at toxic concentrations across the Delta. On each occasion, diazinon was confirmed as being present in toxic water samples by GC/MS analysis. Finally, in 1996 and 1997, TIEs implicated diazinon as the primary contaminant responsible for the toxicity.

Bay Protection Toxic Cleanup Program Guidance prepared by the State Board specifies how to determine what sites or situations should be designated as high priority toxic hot spots (cleanup plans are required for high priority hot spots). The criteria for making this determination for water column toxicity includes consideration of aquatic life impacts, exceedances of water quality objectives, the areal extent of the impairment, identification of sources and potential for natural remediation. Aquatic toxicity has been demonstrated to occur repeatedly through toxicity tests , TIEs and chemical confirmation. The extent of impairments is widespread and the sources are limited to one activity (dormant spray applications). This impairment will not be corrected by natural processes.

In 1999, the Central Valley Regional Water Quality Control Board (Regional Board) determined that diazinon in orchard dormant spray runoff caused toxic conditions in the Sacramento-San Joaquin Delta that warranted identifying the entire Delta as a candidate high priority toxic hot spot. In making this determination, the Regional Board specifically concluded that the pattern of pesticide detections were frequent and merited consideration as a high priority toxic hot spot. The Consolidated Hot Spot Cleanup Plan adopted by the State Board in 1999 in Resolution No. 99-065 identified this candidate hot

spot as a known toxic hot spot. Tables in the Statewide Consolidated Hot Spot Cleanup Plan (see pages 5-3 through 5-7) summarizes the determinations that support the staff recommendation that the entire Sacramento-San Joaquin River Delta be listed as a high priority toxic hot spot for diazinon.

A. Areal Extent

Studies demonstrated that the potential areal extent of diazinon water column contamination from orchard runoff is variable year by year but may include in some years most of the Sacramento-San Joaquin Delta. The Delta is a maze of river channels and diked islands covering some 78 square miles of water area and 1,000 linear miles of waterway.

B. Sources

The only major use of diazinon in agricultural areas in the Central Valley in winter is as a dormant orchard spray. Virtually every study investigating off-site movement into the Rivers and Delta have concluded that the primary source of the chemical is from agriculture (Foe and Connor, 1991; Foe and Sheipline, 1993; Ross, 1992 and 1993; Domagalski, 1995; and Kratzer 1997).

Farmers must report the application of diazinon as a dormant spray and their names and addresses are available through the County Agricultural Commissioner's Office. However, not known at this time is the relative contribution of each application to total offsite movement and what factors influence offsite movement. Such information is essential not only for assessing responsibility but also for successful development and implementation of agricultural management practices.

C. Summary of Actions

The Department of Pesticide Regulation (DPR) and the State Board both have statutory responsibilities for ensuring protection of water quality from adverse effects of pesticides. In 1997, DPR and the State Board signed a management agency agreement (MAA), clarifying these responsibilities. In a companion document, the Pesticide Management Plan for Water Quality (Pesticide Management Plan), a process was outlined for protecting beneficial uses of surface water from the potential adverse effects of pesticides. The process relies on a four-stage approach: Stage 1 relies on education and outreach efforts to communicate pollution prevention strategies. Stage 2 efforts involve self-regulating or cooperative efforts to identify and implement the most appropriate site-specific reduced-risk practices. In stage 3, mandatory compliance is achieved through restricted use pesticide permit requirements, implementation of regulations, or other DPR regulatory authority. In stage 4, compliance is achieved through the State Board and Regional Water Board water quality control plans or other appropriate regulatory measures consistent with applicable authorities. Stages 1 through 4 are listed in a

sequence that should generally apply. However, these stages need not be implemented in sequential order, but rather as necessary to assure protection of beneficial uses.

Currently, DPR is evaluating its regulatory options that can be used to address effects of dormant sprays on surface water. DPR's stated goal is to eliminate toxicity associated with dormant spray insecticides (i.e., chlorpyrifos, diazinon, and methidathion) in the Sacramento and San Joaquin River Basins and Delta.

The U.S. EPA requires Regional Water Boards to maintain 303(d) lists of impaired water bodies. The Sacramento and San Joaquin Rivers and Delta are on the Regional Board's 1998 303(d) list because of elevated concentrations of diazinon. Along with the 303(d) list, the Regional Board approved a schedule for setting Total Maximum Daily Load (TMDLs). Components of a TMDL include problem description, numeric targets, monitoring and source analysis, implementation plan, load allocations, performance measures and feedback, margin of safety and seasonal variation and public participation.

The Regional Board has been working with DPR, interest groups and stakeholders to collect the information needed for development of the components of the TMDLs. Monitoring programs have been implemented and data is being evaluated to determine trends and sources of diazinon entering the Delta. Staff has discussed with and received input from stakeholders (the Sacramento River Watershed Program OP Pesticide Focus Group, for example) on potential numeric water quality targets that would be appropriate for diazinon in the Delta and main tributaries. Alternative implementation frameworks are being evaluated. Staff has worked with stakeholders and CALFED to see that projects are funded for development of alternative management practices that can be implemented to reduce orchard dormant spray discharges to surface waters. Many other groups and entities are involved in development and evaluation of alternative management practices. Some of these are summarized below.

Department of Pesticide Regulation In addition to the activities already discussed, DPR is investigating orchard floor management as a means to reduce discharges of dormant sprays into surface waterways (Ross *et al*., 1997). At an experimental plot at UC Davis, DPR staff measured discharges of chlorpyrifos, diazinon, and methidathion from a peach orchard with three orchard floor treatments. Investigations are continuing in a commercial orchard. At California State University at Fresno, DPR is investigating the effects of microbial augmentation and post application tillage on runoff of dormant sprays. Results will be highlighted in DPR's own outreach activities and will be made available to other groups interested in the identification and promotion of reduced-risk management practices.

DPR has monitored water quality within the Sacramento and San Joaquin river watersheds. In addition, DPR partnered with USGS in 1999 to perform two years of intensive dormant spray season monitoring in the Sacramento River Watershed as part of their dormant spray program.

Novartis (now Syngenta) The registrant of diazinon distributed over ten thousand brochures over the past several years through U.C. Extension, County Agricultural Commissioner's Offices, and Pesticide distributors. The brochure described the water quality problems associated with dormant spray insecticides and recommended a voluntary set of BMPs to help protect surface waters. Novartis intends to repeat the education and outreach program.

Dow Agro Sciences LLC and Novartis The Registrants of chlorpyrifos and diazinon have undertaken a multiyear study in Orestimba Creek in the San Joaquin Basin with the primary objective of identifying specific agricultural use patterns and practices which contribute the bulk of the off-site chemical movement into surface water. The study involves an evaluation of pesticide movement in both winter storms and in summer irrigation return flows. Objectives in subsequent years are to use the data to develop and field test BMPs to reduce off-site chemical movement. The first year of work is complete and a report is available.

Dow AgroSciences is also conducting a study to characterize the benthic communities and physical habitat in Arcade Creek and Orestimba Creek. In addition to monitoring, Dow AgroSciences is developing a pesticide transport model integrating field-scale spray drift, runoff, and irrigation tailwater pesticide inputs with stream transport and fate.

U.C. Statewide Integrated Pest Management Project In late 1997 the U.C. Statewide Integrated Pest Management Project (IPM) was awarded a two year grant by the State Water Resource Control Board to: (1) identify alternate orchard management practices to prevent or reduce off-site movement of dormant sprays, (2) provide outreach and education on these new practices to the agricultural community, and (3) design and initiate a monitoring program to assess the success of the new practices. Also, CALFED has funded a multi-year follow-up study with the same general objectives and the formation of a Steering Committee composed of representatives from Commodity groups, State Agencies including Regional Board staff, and U.C. Academics to serve as a peer review body for the study.

The California Dried Plum Board The California Dried Plum Board (CDPB) has several programs that will lead to reduced pesticide use. The first is the Biologically Integrated Prune Systems (BIPS) program, which is a community-based project that supports implementation of reduced-risk pest management strategies in prune orchards. The reduction or elimination of organophosphate dormant sprays is a goal. The project has a strong outreach component that includes demonstration sites and “hand-on” training for growers and pest control advisors (PCAs). BIPS is a recipient of one of DPR’s pest management grants and is supplemented with funds from USDA’s Cooperative State Research, Education, and Extension Service to implement reduced risk pesticide use in the Sacramento, Feather and San Joaquin River watersheds.

Funds were also acquired from the NRCS Environmental Quality Incentives Program (EQIP) to study management practices designed to prevent the offsite movement of pesticides from orchards. Demonstration of the ability of cover crops and hedgerows to

improve soil conditions and reduce pesticide run-off were provided with these funds. The CDPB has also provided up to $300,000/year for demonstration/research of prune production problems relative to reduced risk pesticide use.

Almond Board of California The Almond Board of California has several programs and projects aimed at reducing the adverse impacts of pesticide use on almond orchards. It has also tracked the trends in dormant applications in almond orchards and has substantiated a decrease in dormant OP use and increased use in alternatives through Pesticide Use Report analysis. The Almond Board also participated in a survey of almond industry IPM Practices in order to set a baseline measurement of IPM practices in use and assess pest control practices among almond growers and Pest Control Advisors. In addition, the Almond Board has conducted research on Best Management Practices to minimize the movement of pesticides off-site, softer insecticides, almond varieties with greater pest resistance and pheromone mating disruption regimes, which would minimize the need for insecticide usage. Partner agencies in these projects include DPR, CALFED, the Community Alliance of Family Farmers (CAFF), UC Cooperative Extension and the UC Statewide IPM program.

With funds received from DPR, the Almond Board directs the Almond Pest Management Alliance. This program promotes reduced risk systems of almond production, demonstrates alternative products and practices, and opens channels of communication within the almond industry and with regulators.

The Pesticide Environmental Stewardship Program is funded by the National IPM Foundation and seeks to raise awareness among California almond growers of dormant sprays and their impact upon the environment. This program promotes reduced risk practices and demonstrates alternative products and practices.

The Almond Board's Environmental Task Force pro-actively seeks solutions to emerging environmental challenges, provides a clearinghouse of information for industry data, research results and grower-oriented solutions, informs growers of reduced risk production practices that complement Integrated Pest Management systems, informs consumers about almond growing practices that support good land stewardship, and pursues partnerships to seek ways to improve the impact of agricultural production on water, air and soil sources.

The Almond Board has also produced a Pest Management Strategic Plan developed by almond growers, pest control advisors and UC Extension representatives to plan for the transition away from at-risk pesticides, particularly OPs. This plan includes research, education and regulatory priorities and is being promoted by the Almond Board to be implemented by growers.

Biologically Integrated Orchard Systems (BIOS) The BIOS program pioneered community-based efforts to implement economically viable, non-conventional, pest management practices. It emphasizes management of almond orchards in Colusa, Merced, Madera, and San Joaquin and Stanislaus counties in ways that minimize or

eliminate the use of dormant spray insecticides. BIOS was a recipient of a DPR pest management grant and a federal Clean Water Act (CWA) section 319(h) nonpoint source implementation grant and is managed by UC SAREP and the Community Alliance with Family Farmers.

Biorational Cling Peach Orchard Systems (BCPOS) This project has the same goals as the BIPS program, except that it focuses on primary pests in cling peach orchards. The University of California Cooperative Extension is acting as project leader, with Sacramento and San Joaquin valley coordinators. BCPOS is another recipient of a DPR pest management grant.

Colusa County Resource Conservation District The Colusa County Resource Conservation District (RCD) is leading a runoff management project within the watershed of Hahn Creek. Project participants are trying to identify management practices that reduce runoff from almond orchards within the watershed, thereby reducing pesticide loads in the creek. Outreach and demonstration sites are part of this project. This project was the recipient of a CWA section 319(h) grant.

Glenn County Resource Conservation District The Glenn County Resource Conservation District (RCD) have an EQIP funded program entitled the "Water Quality Educational Program for Producers in Glenn County." This program educates producers in Glenn County about existing water quality regulations, wetland determinations, and ground water quality monitoring.

Glenn County Resource and Planning Department The Glenn County Resource and Planning Department leads the Glenn County Surface Water Stewardship Project. The project is funded through EPA 205(j) and Prop 204 grants to initiate a voluntary program proposing management measures to address the off-site movement of pesticides, nutrients and sediment from agricultural sources.

Natural Resources Conservation Service-Colusa Office The Colusa County office of the Natural Resources Conservation Service (NRCS) was recently awarded over $100,000 from the Environmental Quality Incentives Program (EQIP), one of the conservation programs administered by the U.S. Department of Agriculture. EQIP offers contracts that provide incentive payments and cost sharing for conservation practices needed at each site. Most of these funds should be available to help implement reduced-risk pest management practices in almond orchards in the area.

Natural Resources Conservation Service Stanislaus Office The Stanislaus County office of NRCS was recently awarded $700,000 from EQIP. Half of the funds are allocated to address livestock production practices, but most of the remaining funds should be available to address dormant sprays and the implementation of reduced-risk pest management practices. Local work groups, comprised of RCDs, NRCS, the Farm Services Agency, county agricultural commissioners, Farm Bureau, and others will determine how EQIP funds will be distributed. Applicants for EQIP funds will be evaluated on their ability to provide the most environmental benefits.

Coalition for Urban/Rural Environmental Stewardship The Coalition for Urban/Rural Environmental Stewardship (CURES) has provided grower and agricultural consultant outreach on pesticide runoff in surface water. Presentations on Best Management Practices designed to reduce runoff of diazinon dormant sprays from orchards and urban professional uses were given at several commodity/ grower association meetings.

Nature Conservancy The Nature Conservancy initiated a voluntary program of reducing OP pesticides and is enrolling more prune growers in the BIPS project as it proceeds with its Phelan Island restoration project in the Sacramento Valley. This project was supported by a CWA Section 319(h) grant.

Ducks Unlimited Ducks Unlimited has conservation easements for agricultural land. They provide information to local communities on how key habitat areas such as wetlands and riparian systems can assist them in dealing with water management issues, both water quality and flood protection. This project is supported by a CWA Section 319(h) grant.

University of California, Berkeley The University of California at Berkeley has received CALFED funds to assess the effect of pesticides on fish and their food sources in the Sacramento/San Joaquin Delta.

OP Focus Group The OP Focus Group is a subgroup of the Sacramento River Watershed Program. It was formed after the Toxics Subcommittee identified OP pesticides used in the dormant season as a high priority constituent of concern in the Sacramento River Watershed. The OP Focus Group has developed the "Water Quality Management Strategy for Diazinon." This document incorporates the discussions, research, projects and reports completed in the first two years of the group's existence. Included in the Strategy is a source and loading analysis, an implementation plan developed by a newly formed subgroup, known as the Ag Implementation Group (AIG), a management practices overview and analysis, a summary of proposed activities by regulatory agencies and eleven appendices of supporting documents.

The OP Focus Group has successfully applied for and been awarded four grants totaling $1.4 million to implement the strategy. Demonstration farms and a grower outreach campaign are key elements of the projects targeted to almond, dried plum and peach growers who farm in the Sacramento and Feather River watersheds. Demonstration sites throughout Butte, Glenn, Sutter and Yuba Counties will study and showcase pest control and orchard management practices to protect surface water. In addition to the demonstration sites, a comprehensive outreach and education program is an important component of the Water Quality Management Strategy for Diazinon.

D. Assessment of Actions Required

As has been discussed in the previous section, there are many efforts underway to develop and evaluate alternative management practices that can be used to reduce the

levels of diazinon in surface waters. However, there is no comprehensive program or framework in place to assure that a suite of practices will be implemented in a manner that will assure that dormant orchard spray discharges do not continue to cause impairments. This cleanup plan establishes a time schedule for development of basin plan amendments to implement a comprehensive program. At a minimum, the comprehensive program will include water quality objectives for diazinon, an implementation program and schedule, a monitoring program and required elements of TMDLs that will apply to the Sacramento River, San Joaquin River and Delta.

Proposed actions and provisions that will be considered for inclusion in the Basin Plan must be consistent with existing state and federal regulations, policies, and provisions, including those in the State Porter-Cologne Water Quality Control Act, the Federal Clean Water Act, the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins (Basin Plan), the BPTCP and other statewide policies and plans. In addition, actions will need to be consistent with any policies addressing waivers of waste discharge requirements.

Controlling the loads of dormant orchard sprays entering the Delta from the Sacramento River and the San Joaquin River is expected to correct most of the impairments in the Delta associated with orchard dormant sprays. Additional work will be needed to evaluate other in-Delta sources and other tributaries (such as the Mokelumne River and the Yolo Bypass) and develop control programs for these sources, if warranted. The implementation programs will describe actions that need to be implemented to achieve water quality objectives and the framework that will assure that the actions are implemented. In evaluating implementation framework options, staff will consider all alternatives that are appropriate under state and federal laws and regulations.

In order to assist staff in evaluating alternative management frameworks for eventual incorporation into the Basin Plan, staff will work with DPR to determine an effective process for identifying and implementing management practices that appropriately reduce diazinon runoff into surface waters. As previously mentioned, the concentrations of diazinon observed in surface waters in the winter are likely the result of legal uses of diazinon as an orchard dormant spray. Since DPR has responsibility for regulating pesticide use and sales, DPR should evaluate whether their use requirements need to be adjusted to assure that permitted uses do not contribute to impairments. It is important to determine what actions DPR will initiate in order to determine how to develop the Basin Plan implementation program. Discussions will also be initiated with groups or entities that could be identified in the Basin Plan as being responsible for implementation of actions. Following is the schedule for amending the Basin Plan. Some of the actions on the schedule will be initiated or completed before the amended Cleanup Plan is adopted.

- Prepare technical reports for peer review that include preliminary staff analysis on water quality objectives and implementation alternatives for the Sacramento River and the San Joaquin River. December 2002
- Prepare proposed Basin Plan amendments for Regional Board consideration for Sacramento River and San Joaquin River that include water quality objectives for

diazinon, an implementation program and framework, a compliance time schedule, a monitoring program and other required TMDL elements. August 2003

- Prepare technical reports that include preliminary staff analysis on water quality objectives and implementation alternatives for the Delta. August 2003
- Prepare proposed basin plan amendments for Regional Water Board consideration for the Sacramento-San Joaquin Delta that include water quality objectives for diazinon, an implementation program and framework, a compliance time schedule, a monitoring program and other required TMDL elements. August 2004
- Monitor in Delta and upstream to continue to document diazinon concentrations in surface waters. Annually

E. Estimated Costs of Implementing Control Program

Costs associated with implementation of alternative management practices (aside from grants awarded for demonstration or pilot projects) will be borne by growers implementing alternative management practices. Additional costs will be borne by DPR, County Departments of Agriculture, Regional Board, Irrigation districts, and/or other agencies and entities that would be part of the regulatory framework that is developed to assure compliance with water quality objectives. There will be some costs associated with monitoring to verify sources in the Delta and the success of control programs. Resources are already allocated to further define sources in the Sacramento River and San Joaquin River. The most effective implementation program will allow for implementation of new, improved practices as they are developed. Therefore, there will be an ongoing need for resources to evaluate new alternative management practices.

Following is an estimate of costs to implement the diazinon orchard dormant spray cleanup plan.

Task	Cost
Regional Board staff costs to develop Basin Plan proposal	Resources available from TMDL program
Monitoring costs to develop program	Resources available from TMDL program
Continued practices development	$100,000 to $1,000,000 per year
Implementation of practices	Depends on alternatives selected (see below)
Regulatory agency costs to oversee	Depends on regulatory framework
Monitoring for program effectiveness	$100,000/yr in Delta only

Alternative management practices for dormant orchard runoff includes the use of non-economic crops to produce soil cover between orchard trees, known as cover crops. Cover crops prevent soil erosion, increases runoff infiltration and accelerates the biodegradation of pesticides in soil. Many orchards in the Central Valley already utilize cover crops, however the exact acreage is not known. It is estimated that use of cover crops costs $35-$70 per acre. Similarly, use of filter strips between crops and waterways can reduce runoff, trap sediment and increase infiltration. It is estimated that a 10-foot strip bordering 100 acres would cost between $37 and $562, dependent on the vegetation chosen and level of maintenance (Sacramento River Watershed Program, 2001).

New sprayer technology is available that produces more efficient tree coverage while, at the same time, allowing for reductions in pounds of pesticides applied. Retrofitting sprayers with electronic sensors that detect the presence or absence of foliage and make adjustments accordingly, including turning off the sprayers in between trees and rows, reduces the overall volume of pesticide applied. Each sensor costs between $3,000 and $4,000 (Sacramento River Watershed Program, 2001).

Changes to pesticide application patterns (alternate year spraying and/or only spot treating infestations as they occur) can greatly reduce quantity of pesticide released into the environment as well as reduce pesticide application costs. However pest monitoring by a trained pest control advisor (PCA)/field scout is recommended to ensure that applying diazinon every other year or as needed will sufficiently control the pest pressure for a given orchard. Another potential alternative practice involves applying sprays early or late in the dormant season in order to avoid large storms (typically occurring in January and February) and allows dormant sprays to degrade naturally prior to being washed offsite in winter storms (research is still being evaluated for effectiveness under Central Valley conditions). In many cases, there are little or no economic costs associated with changing application patterns. For example, for alternative year spraying, additional costs for pest monitoring may be offset by cost savings from applying pesticides every other year.

Other options include using alternate products such as pyrethroids instead of diazinon. Although there are certain environmental concerns with the switching of one pesticide with another, many orchardists already utilize pyrethroid products such as esfenvalerate. Typical costs to apply esfenvalerate during the dormant season are $25/acre compared to $18/acre for diazinon (Sacramento River Watershed Project, 2001).

The choice of alternative practices to be implemented will be up to individual growers. Valley-wide implementation costs will be dependent on the mix of practices selected.

F. Estimate of Recoverable Costs from Potential Dischargers

The Regional Board, DPR and other agencies and parties have spent considerable resources developing the information to support this clean-up plan. These costs are not recoverable. As has been mentioned in the previous section, the cost of implementing the clean-up plan will be largely borne by the farmers using alternative practices and the

regulatory agencies that must oversee control program implementation. Regulatory oversight effort costs could be recovered if waste discharge requirements are part of the regulatory framework that is developed.

G. Two Year Expenditure Schedule Identifying Funds to Implement the Plan That Are Not Recoverable from Potential Dischargers

The Regional Board has resources to develop the framework for the control program. There are various grant programs that may be available to fund implementation of management practices and other aspects of the clean-up plan. State agencies can request budget augmentations to support increased oversight responsibilities. The availability of resources from these sources is unknown. One source of resources to support regulatory agency oversight activities could come from waste discharge requirement fees.

Urban Stormwater Pesticide Cleanup Plan

Background

In 1999, the Regional Board determined that diazinon and chlorpyrifos in urban stormwater runoff caused toxic conditions in the Sacramento-San Joaquin Delta that warranted identifying several Delta back sloughs and creeks collectively as a candidate high priority toxic hot spot. The Consolidated Hot Spot Cleanup Plan adopted by the SWRCB in 1999 in Resolution No. 99-065 identified this candidate hot spot as a known toxic hot spot. Diazinon and chlorpyrifos from urban runoff have also been noted in the Central Valley Region's 303(d) list as a water quality impairment in Delta back sloughs and creeks. This cleanup plan primarily addresses the cleanup requirements of the BPTCP but was also written to be consistent with the proposed actions and schedules of the 303(d) listing.

Three hundred and forty thousand pounds of diazinon and seven hundred and seventy five thousand pounds of chlorpyrifos active ingredients were used in landscape and structural pest control in California in 1994 for control of ants, fleas and spiders (Scanlin and Cooper, 1997; Department of Pesticide Regulation, 1996). However, these figures do not include homeowner purchases and likely underestimates total use by about one half. In February and again in October 1994 *Ceriodaphnia* toxicity test mortality was reported in Morrison Creek in the City of Sacramento and in Mosher Slough, 5 Mile Slough, Calaveras River, and Mormon Slough in the City of Stockton (Connor, 1994; 1995). All these water bodies are within the legal boundary of the Delta. A modified phase I TIE was conducted on samples from each site implicated metabolically activated pesticide(s) (such as diazinon and chlorpyrifos) were responsible for the toxicity. Chemical analyses demonstrated that diazinon and occasionally chlorpyrifos were present at toxic concentrations. A phase III TIE was conducted on water collected from Mosher Slough on 1 May 1995 that confirmed that the primary cause of acute toxicity was a combination of diazinon and chlorpyrifos.

Background concentrations of diazinon in urban storm runoff in the Central Valley increase after application on orchards in January and February suggesting that urban use might not be the sole source of the chemical at this time (Connor, 1996). Volatization following application is known to be a major diazinon dissipation pathway from orchards (Glotfelty et al., 1990) and a number of dormant spray insecticides have previously been reported in rain and fog in the Central Valley (Glotfelty et al., 1987). Therefore composite rainfall samples were collected in South Stockton in 1995 that demonstrated that diazinon concentrations in rain varied from below detection to about 4,000 ng/l (ten times the acute *Ceriodaphnia* concentration). The rainfall study was continued through March and April 1995 to coincide with application of chlorpyrifos on alfalfa for weevil control. Chlorpyrifos concentrations in composite rainfall samples increased, ranging from below detection to 650 ng/l (again 10 times the acute *Ceriodaphnia* concentration). However, unlike with diazinon, no study was conducted on street runoff to ascertain whether agricultural inputs might be a significant urban source.

Similar invertebrate toxicity test results coupled with TIEs and chemical analysis from the San Francisco Bay Area suggest that diazinon and chlorpyrifos may be a regional urban runoff problem (Katznelson and Mumley, 1997). This finding prompted the formation of an Urban Pesticide Committee (UPC). The UPC is an ad hoc committee formed to address the issue of toxicity in urban runoff and wastewater treatment plant effluent due to organophosphate insecticides, in particular diazinon and chlorpyrifos. The UPC is composed of staff from the U.S. EPA, the San Francisco and Central Valley Regional Water Quality Control Boards, DPR, Novartis and Dow Elanco, municipal storm water programs, the Bay Area Stormwater Management Agencies Association, County Agricultural Commissions, wastewater treatment plants, the University of California and consultants. The members of the UPC are committed to working in partnership with the various stakeholders to develop effective measures to reduce the concentrations of organophosphate insecticides in urban runoff and wastewater treatment plant effluent.

In conclusion, a combination of toxicity test, chemical and TIE work demonstrate that diazinon and chlorpyrifos are present in urban stormwater runoff discharged to urban creeks and back sloughs around the cities of Sacramento and Stockton at concentrations toxic to sensitive invertebrates. The source of the diazinon appears to be primarily from urban sources, although agricultural orchard use may also be important. Chlorpyrifos appears to be predominately of urban origin but the impacts from agricultural use need to be evaluated. Similar results from urban sites in the Bay area indicate that pesticide storm runoff is a widespread problem.

The Regional Board monitoring focused on *Ceriodaphnia* toxicity tests, TIEs and water column chemistry because these measures of aquatic toxicity were specifically identified in the BPTCP as tools that could be used to define toxic hot spots. The use of *Ceriodaphnia* in the BPTCP as an indicator of aquatic toxicity was an innovative and sound approach. An analysis of 49 independent studies (U.S. EPA, 1999) concluded that the *Ceriodaphnia* test has been a particularly reliable predictor of instream biological impacts. In 1995, the Society for Environmental Toxicology and Chemistry assembled a panel of experts to analyze the question of how reliably the results of laboratory single species tests (such as the U.S. EPA *Ceriodaphnia* toxicity test) predict aquatic population responses. The panel concluded that, "it is unmistakable and clear that when the U.S. EPA toxicity test procedures are used properly, they are reliable predictors of environmental impact provided that the duration and magnitude of exposure are sufficient to effect resident biota" and that "a strong predictive relationship exists between ambient toxicity and ecological impact."

Bay Protection Toxic Cleanup Program Guidance prepared by the State Board specifies how to determine what sites or situations should be designated as high priority toxic hot spots (cleanup plans are required for high priority hot spots). The criteria for making this determination for water column toxicity includes consideration of aquatic life impacts, exceedances of water quality objectives, the areal extent of the impairment, identification of sources and potential for natural remediation. Aquatic toxicity has been demonstrated to occur repeatedly through toxicity tests, TIEs and chemical confirmation. The extent of

impairments from urban pesticide discharges is relatively widespread. This impairment will not be corrected by natural processes, however many of the urban uses are being phased out as a result of a December 2000 agreement between U.S. EPA and manufacturers of diazinon and chlorpyrifos.

In 1999, the Regional Board determined that diazinon and chlorpyrifos in urban runoff caused toxic conditions in numerous back sloughs in the vicinity of Sacramento and Stockton that warranted identifying these sloughs as a candidate high priority toxic hot spot. In making this determination, the Regional Board specifically concluded that the pattern of pesticide detections observed in the sloughs was frequent and clearly fit the definition of a toxic hot spot. The Consolidated Hot Spot Cleanup Plan adopted by the State Board in 1999 in Resolution No. 99-065 identified this candidate hot spot as a known toxic hot spot. The tables in the Statewide Consolidated Cleanup Plan (see 5-3 through 5-7) summarize the determinations that support the staff recommendation that the back sloughs and creeks named above be listed as a high priority toxic hot spot for chlorpyrifos and diazinon.

A. Areal Extent

The potential threat posed by diazinon and chlorpyrifos in urban storm runoff is localized to Morrison Creek in the City of Sacramento and Mosher Slough, 5 Mile Slough, the Calaveras River, and Mormon Slough in the City of Stockton. Together the areal extent of impairment may be up to 5 linear miles of back sloughs within the legal boundary of the Delta. In addition, runoff from urban areas in tributaries to the Delta contribute to the overall loads entering the Delta during storm events.

B. Sources

Detailed information on urban sources is not available for the Central Valley. However, in a Sacramento Stormwater Management Report (Busath, 2001), three sources of pesticides in Sacramento urban creeks were identified: 1) unreported residential and commercial applications, 2) reported applications by licensed pesticide applicators, and 3) pesticides transported from agricultural applications. This report and others (personal communication, Val Connor) suggest that diazinon in rainfall is a significant source in the Central Valley. Monitoring and pesticide use surveys in the Sacramento area confirm Bay area findings (Scanlin and Feng, 1997) that residential areas were a significant source but runoff from commercial areas may also be important.

It is not known what portion of the diazinon and chlorpyrifos found in creeks is attributable to use in accordance with label directions versus improper disposal or over application. However, a preliminary study of runoff from residential properties suggests that concentrations in creeks may be attributable to proper use (Scanlin and Feng, 1997).

C. Summary of Actions

The initial characterization of the pesticide problem through extensive toxicity test, chemical and TIE work occurred in the Central Valley with confirmation in the Bay Area while the follow-up studies identifying sources and loads has primarily occurred in the Bay Area and in the Sacramento urban area. The discovery of diazinon in urban storm runoff in both the Central Valley and San Francisco Bay Region at toxic concentrations to *Ceriodaphnia* led to the formation of the Urban Pesticide Committee (UPC). The objective of the UPC is to provide a forum for information exchange, coordination and collaboration on the development and implementation of a urban pesticide control strategy. An additional advantage of the Committee is that it facilitates a more efficient use of limited resources.

The UPC has prepared three reports describing various aspects of the urban pesticide problem in the Bay Area and a fourth volume describing a strategy for reducing diazinon levels in urban runoff. The first report provides a compilation and review of water quality and aquatic toxicity data in urban creeks and storm water discharges in the San Francisco Bay Area focusing on diazinon (Katznelson and Mumley, 1997). The review also includes a discussion of the potential adverse impact of diazinon on aquatic ecosystems receiving urban runoff. The second report characterizes the temporal and spatial patterns of occurrence of diazinon in the Castro Valley Creek watershed (Scanlin and Feng, 1997). Runoff at an integrator point for the entire watershed was sampled during multiple storms to record both seasonal and within-event variations in diazinon concentration. The purpose of the third report was to compile information on the outdoor use of diazinon in urban areas in Alameda County including estimates of quantity applied, target pests, and seasonal and long term trends (Scanlin and Cooper, 1997). This information will be used in the development of a strategy to reduce the levels of diazinon in Bay Area creeks. Finally, the UPC has produced a strategy for reducing diazinon levels in Bay Area creeks (Scanlin and Gosselin, 1997). Since pesticides are regulated on the state and national level, much of the strategy focuses on coordinating with enforcement agencies. The strategy presents a framework of roles and responsibilities that can be taken by various agencies to achieve the overall goal. The strategy focuses on diazinon as it is the most common insecticide detected at toxic levels. In the Central Valley both diazinon and chlorpyrifos are regularly observed and must be simultaneously addressed in any cleanup plan.

Many other groups and entities are developing and implementing programs to reduce pesticide concentrations in urban stormwater runoff. Some of these activities are summarized below.

CALFED OP Pesticide Toxicity Control Project: The Sacramento Stormwater Program conducted a CALFED grant study to evaluate OP pesticides in Sacramento area waterways from 1998 - 2001. The grant study involved 12 months of intensive diazinon and chlorpyrifos monitoring in Sacramento urban runoff, creeks, and rain, and in the Sacramento and American Rivers. The monitoring data was used to characterize the concentrations of diazinon and chlorpyrifos in these waterbodies.

Another major element of this CALFED study was the development of a public education and outreach program to encourage Sacramento area residents to reduce their pesticide use. This was the start of the Water Wise Pest Control Program that is still being implemented throughout Sacramento.

Water Wise Pest Control Program: The Water Wise Pest Control Program is a cooperative effort of the Sacramento Stormwater Management Program, the UC Integrated Pest Management (IPM) Program, the UC Cooperative Extension Master Gardener Program, and, recently, the Sacramento Regional County Sanitation District. The Water Wise Program promotes IPM to Sacramento residents through Master Gardener workshops, presentations, and plant clinics. Informational material is provided through pest-specific consumer cards that describe IPM methods to control the targeted pest. The Water Wise Program is also promoted at various public events, retail nurseries and through newspaper, radio, and television. Since it began in 2000, over 25,000 pest cards have been distributed to Sacramento area residents.

Pesticide Control Operator Outreach: During the 2001-02 program year, the Sacramento Stormwater Management Program, the Sacramento Regional County Sanitation District, and the City of Modesto Stormwater Program sponsored pesticide control operator (PCO) outreach presentations by the Coalition for Urban/Rural Environmental Stewardship (CURES). CURES gave presentations to over 400 PCOs. The presentations informed PCOs about the problems from pesticides contaminating urban runoff and waterways and methods to prevent this contamination from occurring. CURES will be giving a similar series of presentations during the 2002-03 year providing more specific information on proper techniques to prevent pesticides contaminating urban runoff.

As was explained in the diazinon orchard dormant spray cleanup plan, DPR and the State Board both have statutory responsibilities for ensuring protection of water quality from adverse effects of pesticides. In 1997 DPR and the State Board signed a management agency agreement (MAA), clarifying these responsibilities. In a companion document, the Pesticide Management Plan for Water Quality (Pesticide Management Plan), a process was outlined for protecting beneficial uses of surface water from the potential adverse effects of pesticides. The process relies on a four-stage approach: Stage 1 relies on education and outreach efforts to communicate pollution prevention strategies. Stage 2 efforts involve self-regulating or cooperative efforts to identify and implement the most appropriate site-specific reduced-risk practices. In stage 3, mandatory compliance is achieved through restricted use pesticide permit requirements, implementation of regulations, or other DPR regulatory authority. In stage 4, compliance is achieved through the State Board and Regional Board water quality control plans or other appropriate regulatory measures consistent with applicable authorities. Stages 1 through 4 are listed in a sequence that should generally apply. However, these stages need not be implemented in sequential order, but rather as necessary to assure protection of beneficial uses.

The Regional Board has been working with DPR, the cities of Sacramento and Stockton, interest groups and stakeholders to collect the information needed for development of the

components of the TMDLs (required for 303(d) listings) for the discharges of pesticides from Sacramento and Stockton. Monitoring programs have been implemented and data is being evaluated to determine trends and sources of diazinon and chlorpyrifos entering the Delta. Staff has discussed with and received input from stakeholders on potential numeric water quality targets that would be appropriate for diazinon and chlorpyrifos in the Delta and main tributaries. Alternative implementation frameworks are being evaluated. Staff has worked with stakeholders and CALFED to see that projects are funded for development of alternative management practices that can be implemented to reduce urban discharges of pesticides to surface waters.

D. Assessment of Actions Required

The development of a comprehensive program will include the following elements: identification of a target, location of sources, evaluation of source control options, allocation of source reduction responsibilities, development of an implementation plan and framework and establishment of a monitoring and evaluation program to demonstrate compliance. This cleanup plan includes a time schedule for establishing the framework for assuring that management practices are implemented in a manner that produces the anticipated water quality improvements.

As a result of agreements made in 2000 between US EPA and manufacturers of diazinon and chlorpyrifos, almost all non-agricultural uses are being phased out over the next several years. Therefore, short-term efforts should focus on monitoring 1) to evaluate the trends in levels of diazinon and chlorpyrifos and any replacement products, 2) to determine the significance of rainfall contributions to the urban pesticide loads and 3) to determine the significance of the permitted urban uses that have not been phased out. Monitoring would be the joint responsibility of the cities and DPR and the Regional Board. Periodically, staff will review monitoring results and make a recommendation to the Regional Board regarding the need for additional control actions.

As is described elsewhere in this cleanup plan, Basin Plan amendments are under development for controlling orchard dormant spray runoff (see Orchard Dormant Spray Cleanup Plan) in the Delta, Sacramento River and San Joaquin River. These amendments should help reduce levels of diazinon and chlorpyrifos in rainfall either directly or because the implemented control program results in less use of the pesticides. These amendments, combined with the urban phase-out of diazinon and chlorpyrifos use is expected to eliminate or greatly reduce impairments from diazinon and chlorpyrifos in the urban creeks.

Existing stormwater permits covering the Sacramento and Stockton urban areas are scheduled to be revised at about the same time that these Cleanup Plans are scheduled for adoption by the Regional Board. As part of the permit adoption process, staff will recommend, for Regional Board consideration, findings, provisions and requirements that are needed to ensure compliance with Basin Plan provisions and to prevent maintenance or further pollution of existing hot spots.

Annually, Regional Board staff will review monitoring data and report to the Regional Board on the success of the initial reduction phase. If the Regional Board determines that the current phase-out of urban uses and anticipated reductions from agricultural sources will not eliminate the impairments, then follow-up actions will be needed. Further reductions may be needed from the remaining permitted urban sources and from agricultural sources that are deposited in the urban areas in rainfall. The relative reduction from each source will be based on each source's relative contribution, the availability of measures that can be implemented and cost.

It is also anticipated that TMDLs that are consistent with Federal and State requirements will be established for the urban creeks and, if necessary, the Basin Plan will be revised. Following is the time schedule for the above actions:

- Adopt revised stormwater permits for the Sacramento and Stockton urban areas that include the following:
    - Monitoring programs to document the effects of the phase-out of urban uses and the significance of the remaining permitted sources. February 2003
    - Other requirements and provisions to prevent maintenance or further pollution of the hot spots. February 2003
- Initiate urban area monitoring. December 2003
- Regional Board, DPR and urban permitees develop monitoring program to characterize the rainfall component. February 2003
- Initiate monitoring to characterize rainfall component. February 2003
- Urban permitees submit monitoring reports. Annually
- Periodic report on monitoring results to Regional Board. Annually
- Establish TMDL for urban creeks. 2005
- Determine need for Basin Plan amendment. 2005
- Amend Basin Plan, if needed. 2007
- Renew stormwater permits. 2008

E. Estimated Costs of Implementing Control Program

Costs for developing and adopting stormwater permits are already budgeted. Costs for monitoring for determining the effectiveness of the phase-out program will be borne largely by the stormwater dischargers in Sacramento and Stockton. DPR and Regional Board resources may be used to supplement monitoring and to evaluate the rainfall component. Continued monitoring in the urban area will be the responsibility of the cities. Costs associated with implementation of alternative management practices (aside from grants awarded for demonstration or pilot projects) in urban areas will be borne by entities regulated by the urban area permit programs. Educational programs and other programs to reduce pesticide use or promote use of alternative practices will be borne by stakeholders included in the implementation plans.

Following is an estimate of costs to implement the diazinon and chlorpyrifos urban stormwater runoff cleanup plan:

Task	Cost
Regional Board staff costs to develop revisions program	Resources available from TMDL permit and stormwater permit program
DPR/Regional Board/urban entities costs to evaluate rainfall	$50,000 per year for three years*
Monitoring costs for urban dischargers to define trends and evaluate urban sources	$50,000/yr in urban creeks
Continued practices evaluation	$50,000 to $100,000 for cities annually
Implementation of practices	Depends on alternatives selected
Regulatory agency costs to oversee	Depends on regulatory framework
RB staff costs to develop TMDL	Resources available from TMDL program
RB staff costs to develop Basin Plan amendment (if needed)	$50,000/yr for two years

* It is anticipated that currently budgeted resources will support this monitoring effort.

F. Estimate of Recoverable Costs from Potential Dischargers

The Regional Board, DPR and urban dischargers have spent considerable resources developing the information to support this clean-up plan. Continued costs will be incurred as all the above entities oversee development and implementation of programs. These costs are not recoverable. The cost of conducting the monitoring and implementing the clean-up plan will be largely borne by the urban dischargers in Sacramento and Stockton, DPR and entities that implement alternative pesticide management strategies.

G. Two Year Expenditure Schedule Identifying Funds to Implement the Plan that Are Not Recoverable From Potential Dischargers

The Regional Board has resources to develop the permit revisions and to develop Basin Plan amendments, if needed. There are various grant programs that may be available to fund implementation of management practices and other aspects of this clean-up plan. State agencies can request budget augmentations to support increased oversight responsibilities. The availability of resources from these sources is unknown.

Irrigation Return Flow Pesticide Cleanup Plan

Background

In 1999, the Regional Board determined that chlorpyrifos in irrigation return flow caused toxic conditions in various agriculturally dominated back sloughs within the Delta that warranted identifying Delta back sloughs as a candidate high priority toxic hot spot. The Consolidated Hot Spot Cleanup Plan adopted by the SWRCB in 1999 in Resolution No. 99-065 identified this candidate hot spot as a known toxic hot spot. Chlorpyrifos has also been noted in the Central Valley 303(d) list as a water quality impairment in the San Joaquin River and Sacramento San Joaquin Delta. This plan primarily addresses the cleanup requirements of the BPTCP but has also been written to be consistent with the schedule for the 303(d) list.

One and a half million pounds of chlorpyrifos active ingredient were used in the Central Valley on agriculture in 1990 (Sheipline, 1993). Major uses in March are on alfalfa and sugarbeets for weevil and worm control and between April and September on walnuts and almonds for codling moth and twig borer control. Two minor uses are on apples and corn. A toxicity test study was conducted in agriculturally dominated waterways in the San Joaquin Basin in 1991 and 1992. Chlorpyrifos was detected on 190 occasions between March and June of both years, 43 times at toxic concentrations to *Ceriodaphnia* (Foe, 1995). Many of the crops grown in the San Joaquin Basin are also cultivated on Delta Tracts and Islands. Not known was whether these same agricultural practices might also contribute to instream toxicity in the Delta. BPTCP resources were used between 1993 and 1995 to conduct a toxicity test monitoring program in the Delta. Chlorpyrifos toxicity was detected on nine occasions in surface water from four agriculturally dominated backsloughs (French Camp Slough, Duck Slough, Paradise Cut, and Ulatis Creek; Deanovic *et al*., 1996; Larson *et al*., 1994). In each instance the *Ceriodaphnia* toxicity test results were accompanied by modified phase I and II TIEs and chemical analysis which implicated chlorpyrifos. On four additional occasions phase III TIEs were conducted (Ulatis Creek 21 March 1995, Paradise Cut 15 March 1995, Duck Slough 21 March 1995, and French Camp Slough 23 March 1995). These confirmed that chlorpyrifos was the primary chemical agent responsible for the toxicity. Analysis of the spatial patterns of toxicity suggests that the impairment was confined to back sloughs and was diluted away upon tidal dispersal into main channels. The precise agricultural crops from which the chemicals originated are not known because chlorpyrifos is a commonly applied agricultural insecticide during the irrigation season. However, the widespread nature of chlorpyrifos toxicity in March of 1995 coincided with applications on alfalfa and subsequent large rainstorms. Follow-up studies are needed to conclusively identify all responsible agriculture practices.

The Regional Board monitoring focused on *Ceriodaphnia* toxicity tests, TIEs and water column chemistry because these measures of aquatic toxicity were specifically identified in the BPTCP as tools that could be used to define toxic hot spots. The use of *Ceriodaphnia* in the BPTCP as an indicator of aquatic toxicity was an innovative and

sound approach. An analysis of 49 independent studies (U.S. EPA, 1999) concluded that the *Ceriodaphnia* test has been a particularly reliable predictor of instream biological impacts. In 1995, the Society for Environmental Toxicology and Chemistry assembled a panel of experts to analyze the question of how reliably the results of laboratory single species tests (such as the U.S. EPA *Ceriodaphnia* toxicity test) predict aquatic population responses. The panel concluded that, "it is unmistakable and clear that when the U.S. EPA toxicity test procedures are used properly, they are reliable predictors of environmental impact provided that the duration and magnitude of exposure are sufficient to effect resident biota" and that "a strong predictive relationship exists between ambient toxicity and ecological impact."

A combination of toxicity test, chemical and TIE work demonstrate that chlorpyrifos was present periodically in at least four agriculturally dominated backsloughs at concentrations toxic to sensitive invertebrates. The source of the chlorpyrifos appears to be from agricultural use. These results have led Regional Board staff to conclude that French Camp Slough, Duck Slough, Paradise Cut, and Ulatis Creek fit the BPTCP criteria for listing as candidate water column toxic hot spots because of elevated concentrations of chlorpyrifos.

Bay Protection Toxic Cleanup Program Guidance prepared by the State Board specifies how to determine what sites or situations should be designated as high priority toxic hot spots (cleanup plans are required for high priority hot spots). The criteria for making this determination for water column includes consideration of aquatic life impacts, exceedances of water quality objectives, the areal extent of the impairment, identification of sources and potential for natural remediation. Aquatic toxicity has been demonstrated to occur repeatedly through toxicity tests, TIEs and chemical confirmation. The extent of impairments from irrigation return flow is relatively widespread. This impairment will not be corrected by natural processes.

In 1999, the Regional Board determined that chlorpyrifos in agricultural return flow caused toxic conditions in numerous back sloughs in the Delta that warranted identifying these sloughs as a candidate high priority toxic hot spot. In making this determination, the Regional Board concluded that the pattern of pesticide detections observed in the sloughs was frequent and clearly fit the definition of a toxic hot spot. The 1999 State Board resolution adopting the Consolidated Hot Spot Cleanup Plan (Resolution No. 99-065) identified this candidate hot spot as a known toxic hot spot. The tables in the Statewide Consolidated Cleanup Plan (see pages 5-3 through 5-7) summarize the determinations that support the staff recommendation that the back sloughs in the Delta named above be listed as a high priority toxic hot spot for chlorpyrifos.

A. Areal Extent

The potential aquatic threat posed by chlorpyrifos in agricultural return flow is confined to the four previously named Creeks and Sloughs. The areal extent of the impairment may be up to 15 linear miles of waterway within the legal boundary of the Delta.

B. Sources

The only major use of chlorpyrifos in these four drainage basins is on agriculture. Detailed follow-up studies are needed to determine the crop and precise agricultural practice which led to the off-site movement. While it is not known at this time what the relative contribution of each application is, illegal use of pesticides has not been implicated as a significant component of the loads entering surface waters. It would appear that legal use of the pesticide is resulting in the observed water quality problems.

C. Summary of Actions

The Department of Pesticide Regulation (DPR) and the State Board both have statutory responsibilities for protecting water quality from adverse effects of pesticides. In 1997, DPR and the State Board signed a management agency agreement (MAA), clarifying these responsibilities. In Pesticide Management Plan, a process was outlined for protecting beneficial uses of surface water from the potential adverse effects of pesticides. The process relies on a four-stage approach: Stage 1 relies on education and outreach efforts to communicate pollution prevention strategies. Stage 2 efforts involve self-regulating or cooperative efforts to identify and implement the most appropriate site-specific reduced-risk practices. In stage 3, mandatory compliance is achieved through restricted use pesticide permit requirements, implementation of regulations, or other DPR regulatory authority. In stage 4, compliance is achieved through the State Board and Regional Water Board water quality control plans or other appropriate regulatory measures consistent with applicable authorities. Stages 1 through 4 are listed in a sequence that should generally apply. However, these stages need not be implemented in sequential order, but rather as necessary to assure protection of beneficial uses.

The U.S. EPA requires Regional Water Boards to maintain 303(d) lists of impaired water bodies. The Sacramento and San Joaquin Rivers and Delta are on the Regional Board's 1998 303(d) list because of elevated concentrations of chlorpyrifos. Along with the 303(d) list, the Regional Board approved a schedule for setting Total Maximum Daily Load (TMDLs). Components of a TMDL include problem description, numeric targets, monitoring and source analysis, implementation plan, load allocations, performance measures and feedback, margin of safety and seasonal variation and public participation.

The Regional Board has been collecting information needed for development of the components of the TMDLs. Monitoring programs have been implemented and data is being evaluated to determine trends and sources of chlorpyrifos entering the Delta. Staff views irrigation return flow management as mostly a water management problem that should be able to be addressed in a relatively straightforward manner. Staff has discussed this concept with stakeholders. Staff has discussed with and received input from stakeholders on potential numeric water quality targets that would be appropriate for chlorpyrifos in the Delta. Alternative implementation frameworks are being evaluated.

Two activities by other entities are underway in the Central Valley to develop BMPs to reduce pesticide movement into surface water. Each is summarized below.

U.C. Statewide Integrated Pest Management Project. In December 1997 the U.C. Statewide Integrated Pest Management Project was awarded a three year one million dollar grant by the CALFED Bay Delta program. Objectives of the grant are to (1) identify alternate urban and rural BMP practices to prevent and reduce off-site movement of diazinon and chlorpyrifos into surface water. Study is to consider both summer and winter uses of the two insecticides. (2) Provide outreach and education on these new practices to the urban and agricultural community, and (3) design and initiate a monitoring program to assess the success of the new practices. Stanislaus County will be the focus of the study effort.

DowElanco The Registrant of chlorpyrifos has undertaken a multi year study in the San Joaquin Basin at Orestimba Creek to identify the specific agricultural use patterns and practices which contribute the majority of the off-site movement of their product into surface water. The study involves an evaluation of pesticide movement in both winter storms and in summer irrigation return flows. Objectives in subsequent years are to use the data to develop and field test BMPs to reduce off-site chemical movement. The first year of work is complete. A report has been released.

Much similarity exits between agricultural practices in the San Joaquin Basin and the Delta. The results of the DowElanco work may be important in helping to identify the agricultural practices responsible for causing instream toxicity in the Delta and also for developing successful BMPs to solve the problem. All promising solutions need to be field tested in Delta farmland.

D. Assessment of Actions Required

The work described in the previous section will be considered in determining what additional actions are needed to assure that in-season runoff of chlorpyrifos in irrigation tail water does not continue to cause impairments. This cleanup plan establishes a time schedule for development of basin plan amendments to implement a comprehensive program. At a minimum, the comprehensive program will include water quality objectives for chlorpyrifos, an implementation program and schedule, a monitoring program, and required elements of TMDLs that will apply to the Sacramento River, San Joaquin River and Delta.

Proposed actions must be consistent with existing state and federal regulations, policies, and provisions, including those in the State Porter-Cologne Water Quality Control Act, the Federal Clean Water Act, the Basin Plan, the BPTCP and other statewide policies and plans. The implementation framework must be consistent with whatever waiver policy is developed.

Controlling the loads of chlorpyrifos entering the Delta from the San Joaquin River is expected to prevent impairments in the main water masses in the Delta that in the past have been associated with in-season applications. Additional work will be needed to evaluate other in-Delta sources and other tributaries (such as the Mokelumne River and

the Yolo Bypass) and develop control programs for these sources, if warranted. The Basin Plan amendment for the Delta will describe how monitoring results will be evaluated and how impairments in the back sloughs will be addressed. In evaluating implementation program options, Regional Board staff will consider all alternatives that are appropriate under state and federal laws and regulations, including use of waste discharge requirements.

Control actions should logically be focused in two areas: modifying use patterns or practices and modifying irrigation tailwater management practices. In order to assist Regional Board staff in evaluating alternative management frameworks for eventual incorporation into the Basin Plan, staff will work with DPR to determine the actions that the department intends to implement to reduce the levels of chlorpyrifos in surface waters. As previously mentioned, the concentrations of chlorpyrifos observed in surface waters are likely the result of legal uses of chlorpyrifos. Since DPR has responsibility for regulating pesticide sales and use, it would seem appropriate for DPR to evaluate whether their use requirements need to be adjusted to assure that permitted uses do not contribute to impairments. It is important to determine what DPR will do in order to determine how to develop the basin plan implementation program. Discussions will also be initiated with groups or entities that could be identified in the Basin Plan as being responsible for implementation of actions.

The time schedule for accomplishing the above actions is as follows:

- Prepare technical reports that include preliminary staff analysis on water quality objectives and implementation alternatives for the San Joaquin River. December 2002
- Prepare proposed Basin Plan amendments for Regional Board consideration for San Joaquin River that includes water quality objectives for chlorpyrifos, an implementation program and framework, a time schedule, a monitoring program and other required TMDL elements. August 2003
- Prepare technical reports that include preliminary staff analysis on water quality objectives and implementation alternatives for the Delta. August 2003
- Prepare proposed Basin Plan amendments for Regional Board consideration for the Sacramento-San Joaquin Delta that includes water quality objectives for chlorpyrifos, an implementation program and framework, a time schedule, a monitoring program and other required TMDL elements. August 2004

E. Estimated Costs of Implementing Control Program

Costs associated with implementation of alternative management practices (aside from grants awarded for demonstration or pilot projects) will be borne by growers implementing alternative management practices. Additional costs will be borne by the DPR, Agricultural commissioners, Regional Board, Irrigation districts, and/or other agencies and entities that would be part of the regulatory framework that is developed to assure compliance with water quality objectives. There will be some costs associated with monitoring to verify sources in the Delta. The most effective implementation

program will allow for implementation of new, improved practices as they are developed. Therefore, there will be an ongoing need for resources to evaluate new alternative management practices.

Following is an estimate of costs to implement the chlorpyrifos irrigation return flow cleanup plan:

Task	Cost
Regional Board staff costs to develop Basin Plan proposal	Resources available from TMDL program
Monitoring costs to develop proposal	Resources available from TMDL and other
Continued practices development	$100,000/yr
Implementation of practices	Depends on alternatives selected (see below)
Regulatory agency costs to oversee	Depends on regulatory framework
Monitoring for program effectiveness	$100,000/yr in Delta only

Alternative management practices for irrigation return flow includes vegetating irrigation canal banks with native plants which reduces erosion and off site movement of pesticides and nutrients, while enhancing biological diversity and aesthetics (Yolo County RCD, 1999). The cost of vegetating one mile of irrigation canal on both sides is estimated to be about $2,695-$7,747. Another effective management practice is to install tailwater ponds. Tailwater ponds catch and store runoff water while preventing non-point source pollution from reaching surface waters and allows for pesticides to degrade naturally. Approximately, 1 acre per 100 acre field is needed for the pond(s) and the estimated costs for installing a tailwater pond is $3,3730 -$11,525 plus the cost of taking land out of production to construct the ponds. The most effective tailwater ponds for irrigation water management include return flow systems which captures the tailwater and re-circulates it for further irrigation while preventing offsite runoff. Minimum costs for tailwater ponds with return flow systems are estimated to be between $13,580 and $27,555 (Yolo County RCD, 1999).

The choice of alternative practices to be implemented will be up to the individual growers. Valley-wide implementation costs will be dependent on the mix of practices selected.

F. Estimate of Recoverable Costs from Potential Dischargers

The Regional Board, DPR and other agencies and parties have spent considerable resources developing the information to support this clean-up plan. These costs are not recoverable. As has been mentioned in the previous section, the cost of implementing the clean-up plan will be largely borne by the farmers using alternative practices and the regulatory agencies that must oversee control program implementation.

G. Two Year Expenditure Schedule Identifying Funds to Implement Plan That Are Not Recoverable From Potential Dischargers

The Regional Board has resources to develop the framework for the control program. There are various grant programs that may be available to fund implementation of management practices and other aspects of the clean-up plan. State agencies can request budget augmentations to support increased oversight responsibilities. The availability of resources from these sources is unknown. If a permit program were established, some costs could be recovered.

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